

ANALYSIS OF FACTORS CONTRIBUTING TO BULBOUS CAPTURE TRACKS FROM COMETARY DUST PARTICLES IN STARDUST AEROGEL COLLECTOR.

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Introduction: The capture of cometary dust grains in aerogel at the well defined impact velocity of 6.1 km/s resulted in the production of a range of impact cavity morphologies. These tracks range from the classical carrot shaped tracks (type A) seen in laboratory experiments with refractory-solid projectiles, to bulbous tracks with “turnip”-like properties and a stylus (type B), to bulbous stubby tracks (type C) [1,2]. These morphologies must reflect the underlying variation in the structure and strength of cometary dust grains. The capture of cometary dust grains also presents the possibility that the chemical content of projectiles, in the form of volatiles that are released during capture, also contributed to bulbous track features and analyses of the terminal particles and track residues suggest that the volatile content of the projectiles, released preferentially during capture, would have contributed to the range of morphologies seen in the Stardust cometary dust tracks. An additional contributor to track bulb production could come from particle fragmentation during capture and here we present a quantitative analysis of the factors that contribute to the production of bulbous impact cavities in aerogel.

Methods: We reviewed models of the energetics of capture and track formation in aerogel [3,4]. The two track formation models that we examined were 1) the snowplow model presented in [4] and an adiabatic vapor expansion model [5]. Both models predict track scaling characteristics in which the pressure (kinetic or thermal) decay strongly as a function of radius ($P \sim r^{-\alpha}$, where $\alpha \sim [3.3-4]$) but linearly as a function of the shock front or projectile size.

Conclusions: Based on entrance hole diameters, measured and catalogued in [2] we examined the departure of the ratio of apparent projectile diameter as inferred by the entrance diameter versus the maximum track diameter and the implied projectile size. Detailed analysis of the energetic requirements needed to explain the observed departures (bulbiness) of tracks indicates that a significant fraction of the original projectile would be vaporized. On the other hand, projectile fragmentation and spreading requires modest increases in the size of the shock front (which established the boundary conditions for the track) to explain the observed departures from conventional aspect ratios seen in carrot shapes tracks. Thus we find that bulbous feature production is likely to be dominated by projectile fragmentation.

References: [1]Horz et al., *Science*, 2006, 234: 1716-1719 [2] Burchell et al., submitted to *MAPS* 2006. [3] Anderson and Ahrens, 1994, *JGR*, 99:2063-2071. [4]Dominguez et al., 2004 *Icarus*, 172: 613-624 [5] Trigo-Rodriguez et al., submitted to *MAPS* 2007.